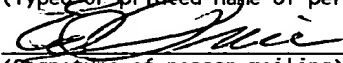


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## **COPY PROTECTION FOR DATABASE UPDATES TRANSMITTED VIA THE INTERNET**

### **CROSS REFERENCE TO RELATED APPLICATIONS**

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The present application is based upon and  
claims priority of U.S. Provisional Application No.  
60/021,702, filed on July 12, 1996.

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### **BACKGROUND OF THE INVENTION**

#### **1. Field of the Invention**

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The present invention relates to a system for  
protecting the unauthorized use of software transmitted  
over a communication link and more particularly to a  
system in which the software is encrypted with a unique  
software key that only allows the software to be  
uploaded into a unit, such as global positioning system  
(GPS) unit, with a matching software key.

#### **2. Description of the Prior Art**

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Global positioning systems are known to be used  
in aircraft and other vehicles for navigation. Such GPS  
systems not only provide the position of the aircraft or  
vehicle but may also be integrated with topographical  
and/or navigational data, such as terrain and airport  
topographical data as well as highway maps stored in a

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database, to provide an indication of the vehicle or aircraft relative to the topographical data or highway information. For example, as disclosed in U.S. Patent Application Serial No. 08/509,642 filed on July 31, 1995, assigned to the same assignee of the present invention, the topographical data, such as the elevation of the highest obstacles within a predetermined region, are stored in a memory device aboard the aircraft. The GPS allows the topographical data to be displayed as a function of the position of the aircraft.

Often times, the topographical and navigational data needs to be updated due to changing topography and highway information. Because of the relative ease in which software that is transmitted over the Internet can be duplicated, updates of the topographical data is known to be provided in a diskette or cartridge form and mailed to the customers. Typically, users of such integrated GPS systems must first determine if an update is available by checking with the database vendor. Orders are typically placed by telephone. The update diskette or cartridge is then mailed to the customer. As such, from the time the order is placed, considerable time passes before the updated topographical data is actually received by the customer so it can be uploaded into the customer's integrated GPS unit. The delay is even more acute for international customers for which the mailing time is considerably greater.

There are other problems associated with providing updated topographical and navigational data on diskettes or cartridges to a customer. For example, for customers that have multiple integrated GPS units, the customer may choose to upload the updated data onto such multiple units even though the customer has only paid for the update for a single unit. The customer may also transfer the update diskette or cartridge to another unauthorized user.

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### SUMMARY OF THE INVENTION

It is an object of the present invention to solve various problems in the prior art.

It is yet another object of the present invention to provide a system for preventing  
5 unauthorized use of a database or other software transmitted over a communication link, such as the Internet.

Briefly, the present invention relates to a  
10 system for transmitting a database or other software over a communication link, such as the Internet, which prevents unauthorized use. In order to prevent such unauthorized use, the customer's equipment, such as a  
15 GPS unit, is provided with a unique software key. The updated database is ordered over the communication link by providing the unique software key and may include electronic payment information. The database is  
20 encrypted, for example, as a function of the unique software key and transmitted over the communication link in encrypted form along with an upload program. The upload program only allows the encrypted database to be  
25 uploaded into a unit with a matching software key. As such, the system allows updated databases to be transmitted rather quickly and easily over a communication link while preventing unauthorized use.

### DESCRIPTION OF THE DRAWINGS

These and other objects of the present invention will be readily understood with reference to  
30 the following specification and attached drawings wherein:

FIG. 1 is a graphical illustration of an exemplary Internet page layout in accordance with the present invention;

35 FIG. 2 is a simplified representation of a dialog box which may form a part of one of the Web pages

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for user information, such as the unique software key,  
in accordance with the present invention;

FIG. 3 is a simplified view of a personal  
computer interfacing with an Internet server in order to  
5 provide user information;

FIG. 4 is similar to FIG. 2 illustrating the  
process of downloading the software from the Internet to  
a user's personal computer;

FIG. 5 is a simplified graphical representation  
10 illustrating the uploading of the software from the  
Internet being transferred between a personal computer  
and a product, such as an integrated global positioning  
system (GPS) unit;

FIG. 6 is a block diagram illustrating the data  
15 flow and the organization of the software on the  
Internet server in accordance with the present  
invention;

FIG. 7 is a simplified flowchart illustrating a  
portion of the system in accordance with the present  
20 invention for ordering software over the Internet;

FIG. 8 is a graphical representation of a  
dialog box for user payment information which may form a  
portion of one of the Web pages illustrated in FIG. 1 in  
accordance with the present invention;

FIG. 9 is a graphical illustration of a dialog  
25 box for enabling users to provide information regarding  
the requested software as well as a unique software key  
which may form a portion of one of the Web pages  
illustrated in FIG. 1 in accordance with the present  
30 invention;

FIG. 10 is a graphical illustration of a dialog  
box for the user's desired payment method which may form  
a portion of one of the Web pages illustrated in FIG. 1  
in accordance with the present invention;

FIG. 11 is a graphical illustration of a  
35 confirmation page which may form a portion of one of the

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Web pages illustrated in FIG. 1 which enables the user to download software over the Internet in accordance with the present invention;

FIG. 12 is a flowchart of the system in accordance with the present invention which provides copy protection for software transferred over the Internet in accordance with the present invention;

FIG. 13 is a flowchart of the software at the server for encrypting the software to be transferred over the Internet in accordance with the present invention; and

FIG. 14 is a flowchart of the decryption process for uploading software transferred over the Internet to a customer's unit, such as an integrated global positioning system (GPS) unit.

#### **DETAILED DESCRIPTION**

The present invention relates to a system for preventing unauthorized use of a database or other software transmitted over a communication link, such as the Internet, for use in particular electronic equipment, such as a global position system (GPS) unit. As mentioned above, such systems utilize topographical data for various regions of the world in order to display the topographical data as a function of the position of the aircraft. Heretofore such GPS units have been sold with topographical and/or navigational data stored in a database on cartridges or diskettes. Updated databases are known to be shipped through the mail. Such a process takes a relatively long period of time. The system in accordance with the present invention allows the database update to be transmitted over communication links, such as the Internet quickly and easily while virtually eliminating unauthorized use of the database information. More particularly, each GPS unit is provided with a unique software key. The

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ROM  
or  
cartridge  
memory  
of key

5 unique key is an 8 digit hexadecimal number, which may be embedded in a read only memory (ROM) within the GPS unit or stored within a removable cartridge at the factory prior to a GPS unit being shipped to the customer. The user uses the unique software key to order update software, such as an update database for the GPS unit, over the communication link and upload the database into a GPS unit with a matching software key, for example as illustrated in FIGS. 3, 4 and 5. For  
10 example, the user simply connects to the GPS database or other software vendor's home page on the WorldWide Web. After providing the unique software key number as well as the desired payment method, the database or other software is encrypted as a function of the unique  
15 software key at the Internet server, for example. The encrypted software is transmitted to the user over the Internet along with a decryption program which only allows the software to be uploaded into a GPS unit having a matching key. Since the updated database is  
20 encrypted as a function of the unique software key, any attempts to upload the software into a unit not matching the unique software key will be futile. Although multiple copies of the encrypted database can be made, the system in accordance with the present invention prevents these encrypted copies from being uploaded into  
25 multiple GPS units.

The present invention is suitable for updating the topographical information stored in databases for use with various integrated GPS systems, such as, KLX  
30 100 GPS/COMM, KLN 98/KLN 89B GPS, KLN 90B GPS and KLN 900 GPS, available from AlliedSignal, Incorporated. Although the system in accordance with the present invention is described and illustrated in terms of transferring updated database information for an  
35 integrated GPS over the Internet, the principles of the present invention are clearly applicable to protecting

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virtually any type of software transmitted over  
virtually any communication link; wired or wireless.

PA 5 It is also to be understood that the principles  
of the present invention are also applicable to other  
forms of electronic transfer that do not involve the  
Internet and may be implemented for transferring  
software over virtually any communication link, such as  
a modem and even a wireless link. Moreover, as will be  
discussed in more detail below, a personal computer is  
10 used to access the Internet server, for example, which  
contains the software to be transferred as illustrated  
in FIGS. 3 and 4. The desired software is then  
encrypted and transferred along with a decryption  
program back to the personal computer, which, in turn,  
15 is used to transfer and decrypt the software into a  
separate electronic unit, such as an integrated GPS  
unit. However, it should also be understood that the  
principles of the present invention are also applicable  
to systems in which the desired software is also  
20 transmitted from a remote communication node, such as an  
Internet server, directly to the unit, such as the  
integrated GPS unit itself.

Referring to FIG. 1, an exemplary Web page  
layout is illustrated. The exemplary Web page layout  
25 includes a home page 22. The home page 22 is provided  
with one or more hyperlinks to provide access to the  
succeeding Web pages. As shown, the home page 22, for  
example, as illustrated in FIG. 8, may be provided with  
a hyperlink to a database selection page 24 (FIG. 9).  
30 The database selection page 24 enables a user to select  
the specific database. As mentioned above, depending  
upon the type of integrated GPS unit, various update  
databases are available for transfer over the Internet.  
After the particular database is selected from the  
35 database selection page 24, a hyperlink may be provided  
to a method of payment Web page 26 with hyperlinks to a

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credit card Web page 28 (FIG. 10) and a user password Web page 30. It is to be understood that the payment option is merely optional. The credit card Web page 28 and the user password Web page 30 allow alternate payment methods for the user in systems which include electronic payment. The credit card Web page 28 requires the user's credit card information as well as the unique software key (FIG. 2). Alternatively, the system allows for the customer to contact the software supplier ahead of time and establish an account. In this situation the user merely enters a password for the account as well as the unique software key for the unit. The credit card Web page 28 and the password Web page 30 are provided with hyperlinks to a confirmation page 32 (FIG. 11). The confirmation page 32 is merely exemplary and is not required for practice of the invention. The confirmation page 32 confirms the user's selection for the particular database as well as the method of electronic payment. If the user enters a confirmation, a hyperlink may be provided on the confirmation page 32 to initiate downloading of the updated software, which is linked to a message page 34 which indicates downloading in progress.

FIGS. 3 through 7 illustrate the present invention. As shown, user information is transferred over the Internet to one or more Internet servers 36 by way of a personal computer which may be an IBM compatible personal computer or other personal computer suitable for connection to the Internet. The software is encrypted and then transferred from one or more Internet servers 36 back to the personal computer 38 along with a decryption and upload program. The upload program enables the encrypted database to be uploaded into a product with a matching software key, such as an integrated GPS unit 40.

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The software layout for the system is illustrated in FIG. 6 and includes a user database 40, a master "nav" database 42 and an upload program <sup>43</sup>~~44~~, identified as NETLOAD.EXE. The user information for example, regarding account and password information, etc. is maintained in the user database 40, accessible by the server 36. The topographical information is stored in the master "nav" database file 42, also accessible by the server 36. Once the user provides the unique software key as well as the desired payment method, a copy of the topographical and/or navigation data from a master "nav" file 42 is encrypted as a function of the unique software key, provided by the user and stored in a "keyed DB file" 44. The keyed DB file 44 is then compressed into a zip file 46 and transferred to the user by way of the Internet along with the decryption or upload file <sup>43</sup>~~44~~, identified as NETLOAD.EXE. <sup>43</sup>~~44~~ enables the zip file containing the encrypted database to be uploaded into a product 40 as long as the software key of the product matches the software key to which the database was encrypted. If the software key matches the unique key within the product, the database is decrypted and uploaded into the product.

A simplified flowchart for the system in accordance with the present invention is illustrated in FIG. 7. Initially, the user connects to the database vendor's home page in step 48. Once connected to the database vendor's home page, the user selects a database from the available databases in step 50. Steps 52 and 54 provide for alternate payment methods. If a user wishes to avoid providing credit information over the Internet, the user can obtain a password and an account and become a registered user. Thus, the system checks whether the user is a registered user in step 52. If not, the system assumes the payment will be made by

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credit card in step 54. In both steps 52 and 54, the user also provides the unique software number that is used to encrypt the database as a function thereof. After the payment method and unique software key are entered, a confirmation page is generated in step 56, for downloading the software.

An overall flow chart is illustrated in FIG. 12. Initially, the unique software key, for example, the 8 digit unique software key unique to the GPS system, is read from the GPS unit 40 by the user and entered on the appropriate Web pages as discussed above. The software key may be printed somewhere on the GPS unit 40 to enable the user simply visually read the software key from the unit in step 58. In step 60, the user logs onto the Internet, chooses a database product and provides the unique software key for the GPS unit 40. The system encrypts the selected database as a function of the unique software key and stored into a keyed database file 44 (FIG. 6) in step 62. In order to conserve storage space, the keyed database file 44 may also be compressed in step 63 and transferred to the customer personal computer 38 in step 64 along with a decryption program 44, identified as NETLOAD.EXE. The keyed database file is then uploaded by the user to their GPS unit 40 (FIG. 5) with a matching software key in step 66.

The flowchart for the database encryption or keying is illustrated in FIG. 13. After the user logs onto the Internet, selects a database and provides the unique software key, the system checks in step 68 whether the desired database is a type KLN 90 database. As used herein the KLN 90 type databases relates to the type of processor within the GPS unit 40. In particular, KLN 90 type databases are formatted for use with Intel type processor chips, while the balance of the databases are formatted for use with Motorola type

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processor chips. Due to the different byte storage methods between the two processor styles, the system checks in step 68 whether request is for a type KLN 90 database. If so, a temporary file is created in step 70 with the database key embedded into the original KLN 90 file from a master KLN 90 database file 72, a subset of the master "nav" DB files 42. If the request is for other than KLN 90 type database, the system proceeds directly to step 74. In step 74, starting with the first byte, the byte is encrypted as a function of the database key, for example by cyclic redundancy coding (CRC), as discussed below. After the first byte is coded with the database key, the key is updated for the next byte in step 76. The keyed or encrypted byte is written to an output file 82 for later transmission over the Internet to the user's personal computer 38 in step 78. This process is continued until all of the bytes in the database file have been keyed and written to the output file 82 as illustrated by step 80. After all of the bytes have been written to the output file 82, a footer tag with data from the original file, including checksums, file size, database type, the effective dates and the original database key are written to the output file 82 and sent to the user along with the upload file NETLOAD.EXE in step 82 as discussed above. If the software key in the GPS unit 40 matches the database key, the NETLOAD.EXE file decrypts and uploads the updated database into an integrated GPS unit 40.

FIG. 14 is a flowchart for the decryption program, <sup>45</sup> (NETLOAD.EXE) for uploading the encrypted database software to the GPS unit 40. As mentioned above, the encrypted database file 82 is provided with the encrypted data as well as a footer tag which includes the original software key, checksums, the file size, the database type as well as the effective dates for the database. In step 86, the footer tag is read

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including the software key from the encrypted output  
file 82. As discussed in more detail below, the  
software key from the footer tag is used to decrypt the  
first byte of the database in step 88. After the first  
5 byte is decrypted, the key is updated for the next byte  
in step 90. After the new key is updated, a checksum is  
calculated to determine if there are any errors in the  
data in step 92. The process of steps 88-92 is repeated  
for each byte in the encrypted database file 82, as  
10 indicated by step 94. After all of the bytes in the  
output file 82 have been decrypted, the system checks in  
step 96 to determine whether the checksum for the  
decrypted file matches the original checksum included in  
the footer tag in the output file 82 in step 96. If  
15 there are any discrepancies in the checksum an error  
message is displayed in step 98. If the checksums  
match, the system communicates with the GPS unit 40 in  
step 98<sup>99</sup> and awaits for the GPS unit 40 to send an  
identification packet containing the GPS unit type as  
20 well as the software key. Once the software key and GPS  
unit type are received from the GPS unit 40, the system  
determines in step 100 whether the GPS unit type matches  
the database file requested. If not, an error message  
is displayed in step 102. Otherwise, the system  
25 proceeds to step 104 and ascertains whether the software  
key received from the GPS unit 40 matches the software  
key used to encrypt the database file and contained in  
the footer tag mentioned above. If not, an error  
message is displayed in step 106. Otherwise, the system  
30 proceeds to step 108 where the software key received  
from the GPS unit is used to decrypt the first byte in  
the output file 82. After the first byte is decrypted  
or unkeyed, the key is updated in step 110 for the next  
byte. The steps 108 and 110 are repeated until a  
35 sufficient number of bytes have been unkeyed for a full  
packet as indicated in step 112. Each time a packet is

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full, a packet of decrypted data is sent to the GPS unit 40 in step 114. As indicated in step 116, the process is repeated until all of the bytes in the encrypted database file have been processed.

- 5           Essentially the encryption process is based on cyclic redundancy code (CRC) table of 256 pseudo random numbers from 0 to 255, for example, as illustrated in TABLE 1.

TABLE 1

10	CRC TABLE ENTRY	VALUE
	0	0
	1	1996959894
	2	3993919788
	3	2567524794
15	...	
	...	3188396048
	...	
	...	
	141	2466906013
20	...	
	...	
	237	3736837829
	...	
25	255	

- Initially, a seed CRC value is chosen, for example 13579246. The first byte in the database or source file is read and added to the seed value. For example, if the first byte in the database equates to the number 3, the new byte will be the CRC seed value (13579246) plus the byte read from the file Boolean ANDed with the hexadecimal number FF or 255. For example, adding the value of the source byte 3 to the seed value of 13579246 would equal the number 13579249.

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Taking the number 13579249 and Boolean ANDing it with the hexadecimal number 255 yields the number 241. Therefore, the new byte written to the file as shown in TABLE 2 below will be 241.

TABLE 2

ORIGINAL DATA FILE	NEW DATA FILE	CRC KEY (START = 13579246)
3	241	
132		
204		

After the first byte is keyed or encrypted, the CRC value for the next byte needs to be updated by taking the current CRC value and doing a Boolean EXCLUSIVE OR with the original byte. That value, in turn is Boolean ANDed with the hexadecimal number 255 which provides an index into the CRC table (between 0 and 255). The CRC table value that is looked up with that index is then Boolean EXCLUSIVE Ored with the CRC value shifted to the right 8 places, for example as shown below.

$$134579246 \wedge 3 = 13579245$$

$$13579245 \& 255 = 237$$

$$\text{CRC\_TABLE}[237] = 3736837829$$

$$13579246 \gg 8 = 53043$$

$$3736837829 \wedge 53043 = 3736818166, \text{ which is now}$$

the new CRC value as illustrated in TABLE 3:

TABLE 3

ORIGINAL DATA FILE	NEW DATA FILE	CRC KEY (START = 13579246)
1	3	3736818166
132		
204		

The process is repeated for each byte in the file, for example as shown in TABLE 4 below.

TABLE 4

BYTE NUMBER	ORIGINAL DATA FILE	NEW DATA FILE	CRC KEY (START = 13579246)
1	3	241	3736818166
2	132	122	3201674049
3	204	13	2478254646

The process is repeated for each byte in the file.

In order to decode or decrypt the data bytes, the process is simply reversed starting with the same known seed CRC key and the same base CRC table values, for example as illustrated in TABLE 5 below.

TABLE 5

BYTE NUMBER	KEY DATA FILE	NEW DATA FILE	CRC KEY (START = 13579246)
1	241		
2	122		
3	13		

Initially, the first byte from the keyed file is read, for example 241. The current value of the CRC key (13579246) is subtracted from that value. The result (-13579005) is Boolean ANDed with 255 which provides a result of 3 which was the original starting point for example as shown in TABLE 6 below.

TABLE 6

BYTE NUMBER	KEY DATA FILE	NEW DATA FILE	CRC KEY (START = 1359246)
1	241	3	
2	122		

BYTE NUMBER	KEY DATA FILE	NEW DATA FILE	CRC KEY (START = 1359246)
3	13		

The CRC key is then updated for the next byte. In order to update the CRC key essentially the same method is used as before. The new byte 3 is EXCLUSIVE ORed with the current value of the CRC key (13579246). The result (13579245) is then Boolean ANDed with the hexadecimal number 255 with a result of 237 which is used as an index to look the CRC value in the CRC lookup table. The current example of the index corresponds to a table value of 3736837829. The current CRC key (13579246) is then shifted to the right 8 places. The result 53043 is EXCLUSIVE ORed with the value that was looked up in the CRC table (3736837829) by way of the index 237. The result 3736818166 is the CRC for the new byte, for example as shown in TABLE 7 below.

TABLE 7

BYTE NUMBER	KEY DATA FILE	NEW DATA FILE	CRC KEY (START = 13579246)
1	241	3	3736818166
2	122		
3	13		

For the next byte the current CRC key 3736818166 is subtracted from the next byte read 122, the result being 558149252. This result 558149252 is anded with the hexadecimal number 255 to produce the next byte 132 which, is the original byte number in the original data file. The process is repeated for each byte as shown below in TABLE 8.

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TABLE 8

BYTE NUMBER	KEY DATA FILE	NEW DATA FILE	CRC KEY (START = 13579246)
1	241	3	3736818166
2	122	132	3201674049
3	13	204	2478254646

The process is repeated until the end of the file and the end result is that the output file exactly corresponds to the original file which was encrypted.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. Thus, it is to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described above.

What is claimed and desired to be secured by Letters Patent of the United States is:

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